Space Weather Technical Forecast

Issued on Saturday 28 September 2024 at 01:25 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Chance of M-flares (R1-R2 Blackouts).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with the largest flare a M0.9 at 27/0800 UTC from a region just on or beyond the southeast limb. There are currently eleven sunspot regions on the visible disc, the majority of which are small and simple. The largest region currently on the visible disc is AR3836, in the southeast. This region consists of a number of spots of one polarity, with weak trailing spots of opposite polarity leading to a marginal Cao/Beta configuration. AR3835, near south centre disc, has seen further maturation of penumbra and the growth and consolidation of a number of small intermediate spots. AR3839, near the southeast limb, remains difficult to assess due to foreshortening. This region is considered responsible for the largest flare of the past 24 hours. AR3833 rotated beyond the western limb during 27 Sep.

There were no Earth-directed CMEs observed. A CME seen emerging towards the southeast has been modelled by Enlil to have no Earth-directed component, although reanalysis is currently underway for confirmation.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by ACE at L1, showed a declining trend. Wind speeds eased from around 360 km/s to near 300 km/s. Density was below average. Interplanetary Magnetic Field, Bt, was weak, at or below 7nT. The north-south component, Bz, was weakly variable ranging between +5/-7 nT. Bz was mostly southward directed until 27/1115 UTC, and has since been largely northward. Phi angle was mostly positive (away from the Sun). Geomagnetic activity was Quiet (Kp 0-2) throughout.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 was at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was initially moderate, but fell to background levels around 27/0630 UTC where it has since largely remained. The associated 24-hour fluence was below the Active threshold and has been on a declining trend. The 28/0000 UTC observation was 7.04e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with a chance of further isolated M-class flares. New regions are expected to rotate onto the disc during the period.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Solar Wind / Geomagnetic Activity: No Earth directed CMEs are currently expected. Background solar winds are expected until a possible weak enhancement occurs, from CH76/-, with wind speeds perhaps reaching around 450km/s. The fast wind onset is expected late on Day 1 or during Day 2 (28-29 Sep).

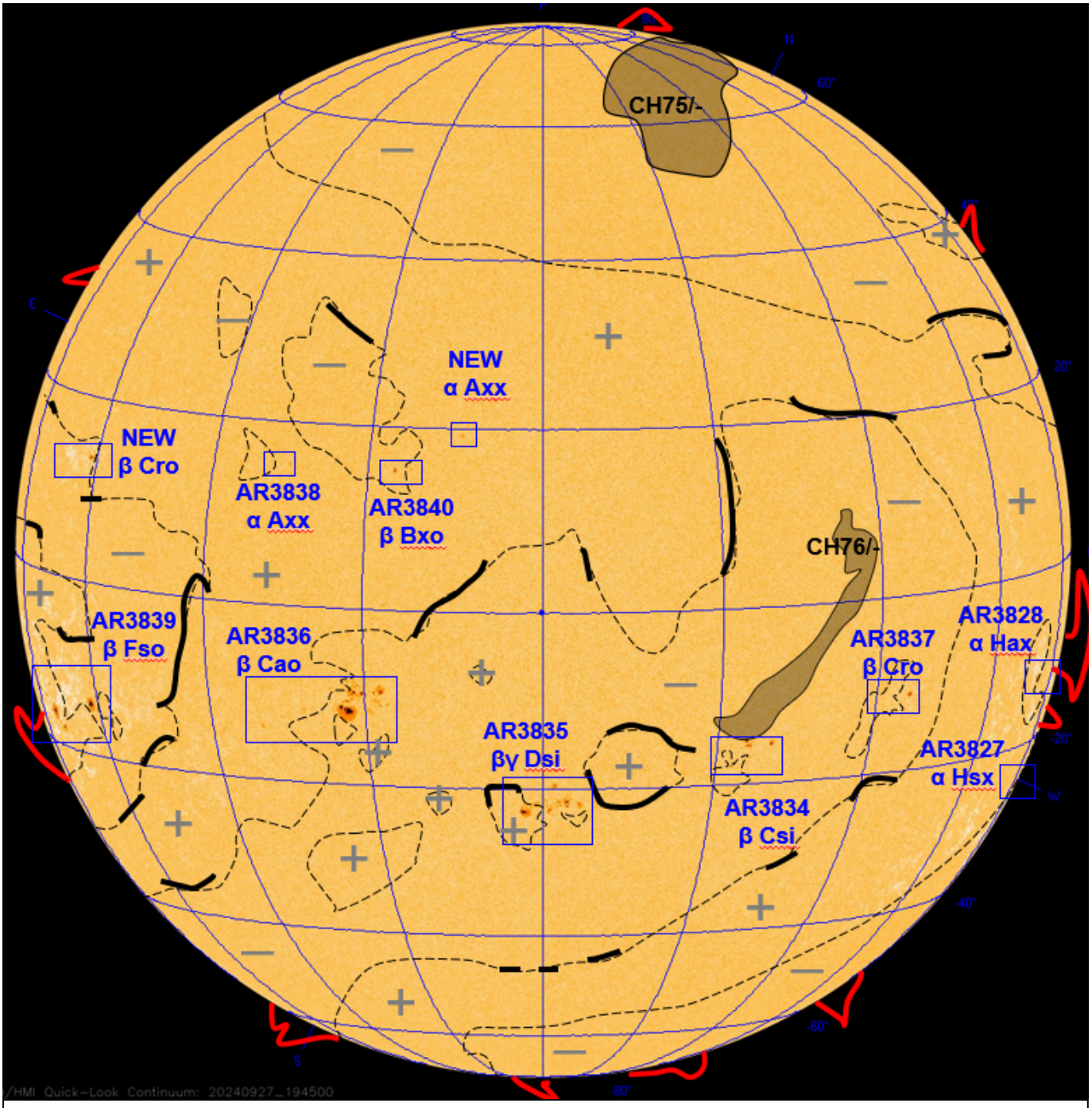
Mainly Quiet (Kp 0-2) geomagnetic conditions are expected. The onset of any fast wind from CH76 could bring a spell of Unsettled to Active (Kp 3-4) intervals late on Day 1 but more likely Day 2.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is forecast to persist at background levels. High energy electron flux at GOES16 is likely to remain largely at background, some slight recovery is possible by Day 4 (01 Oct) but is dependent on HSS enhancement and as such is low confidence. The associated 24 hour fluence is expected to remain below Active (1e8 integrated pfu) throughout.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 1: MOSWOC Solar Synoptic Map valid 27/2000 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Geomagnetic Storms

No Earth directed CMEs are currently expected. A slow CME was observed lifting off from the eastern limb late on 26 Sep. Current Enlil modelling suggests a miss, but the CME is being reanalysed given the relatively low confidence of the original fit.

The current background solar winds are expected to persist until a possible weak enhancement occurs from the arrival of a HSS from CH76/-. This persistent feature lies across the solar equator in the western hemisphere and is expected to connect late on Day 1 (28 Sep) or more probably during Day 2 (29 Sep). On the previous rotation wind speeds of around 450km/s were observed with similar speeds expected this time. As a negative polarity feature, the high speed stream (HSS) is not favoured for a strong connection at Earth so close to the September equinox. MOSWOC Enlil is indicating a strong HSS to develop during this period, but this is considered unlikely with no large coronal holes visible on the disc. SWPM is considered to be giving a reasonable steer during the period, with the coronal hole feature represented in the slight uptick in wind values Days 1-2.

Mainly Quiet (Kp 0-2) geomagnetic conditions are expected for much of this period. The onset of any HSS from CH76 could bring a spell of Unsettled to Active (Kp 3-4) intervals late on Day 2 into Day 3.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 2: MOSWOC Enlil, showing a strong HSS developing during the period. This is currently considered a low probability of occurring.

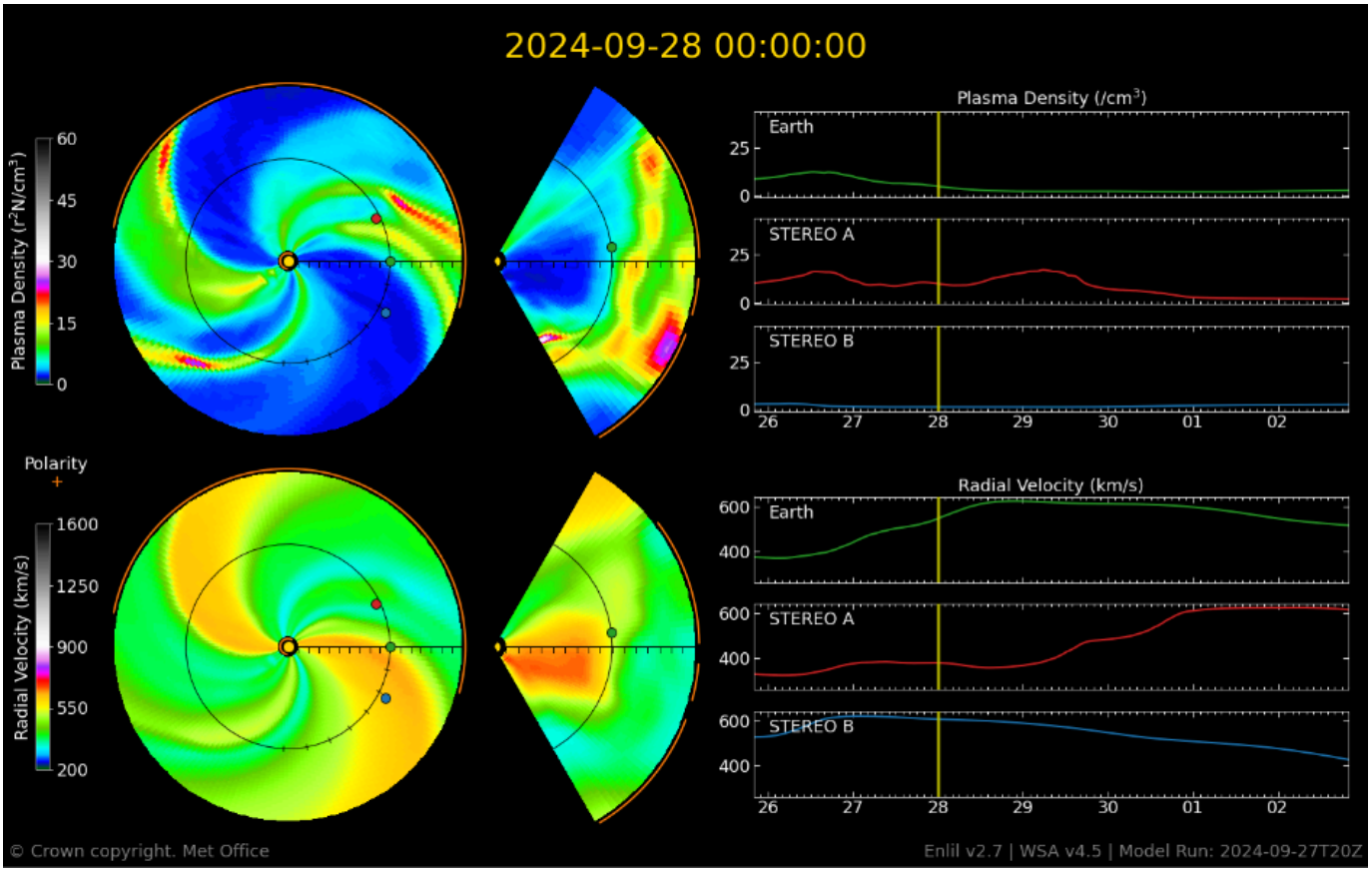
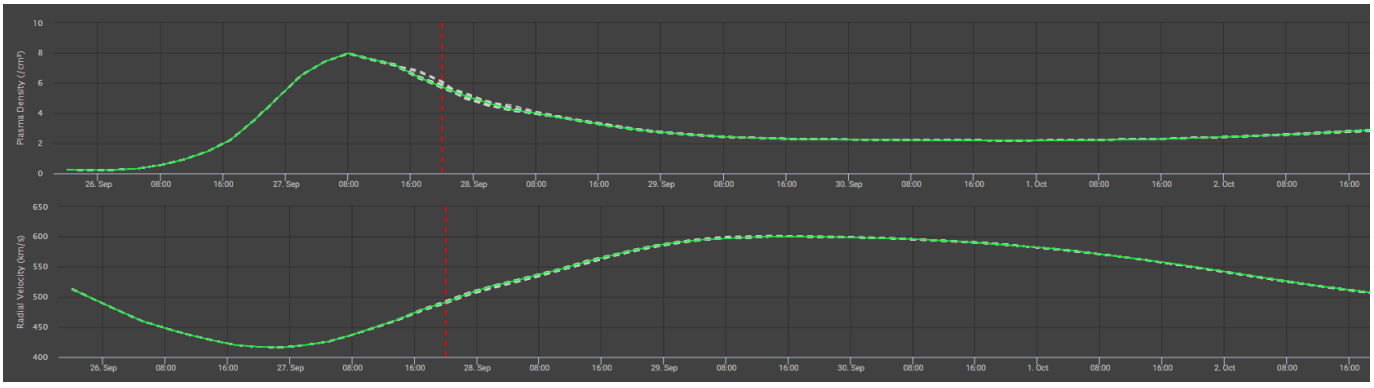
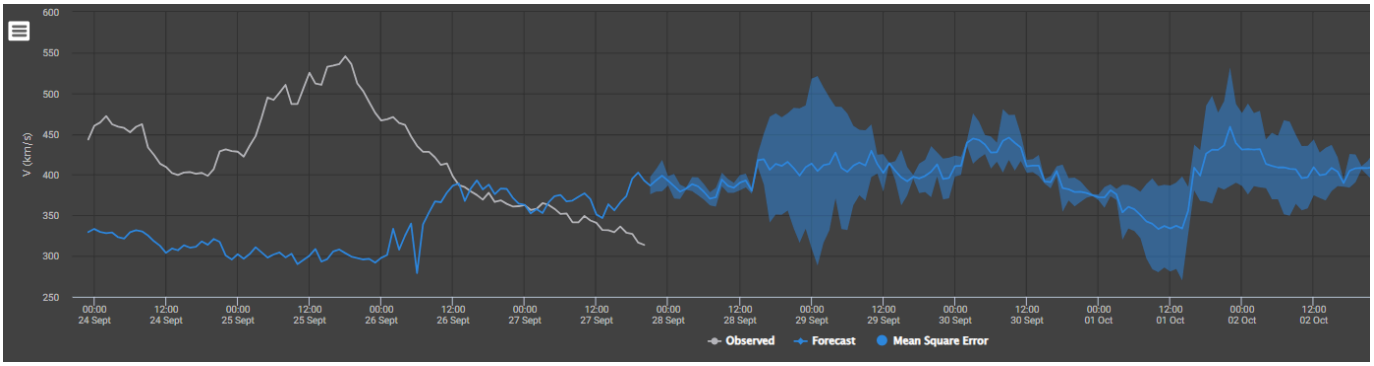


Figure 3: MOSWOC Enlil Ensemble showing minimum spread of solutions. However, the forecast wind speeds are considered too fast.



© Crown Copyright 2024. All Rights Reserved.

Figure 4: MOSWOC SWPM showing suggestion of slightly elevated winds late 28 Sep into 29 Sep.



© Crown Copyright 2024. All Rights Reserved.

Radio Blackouts - X-Ray Flares

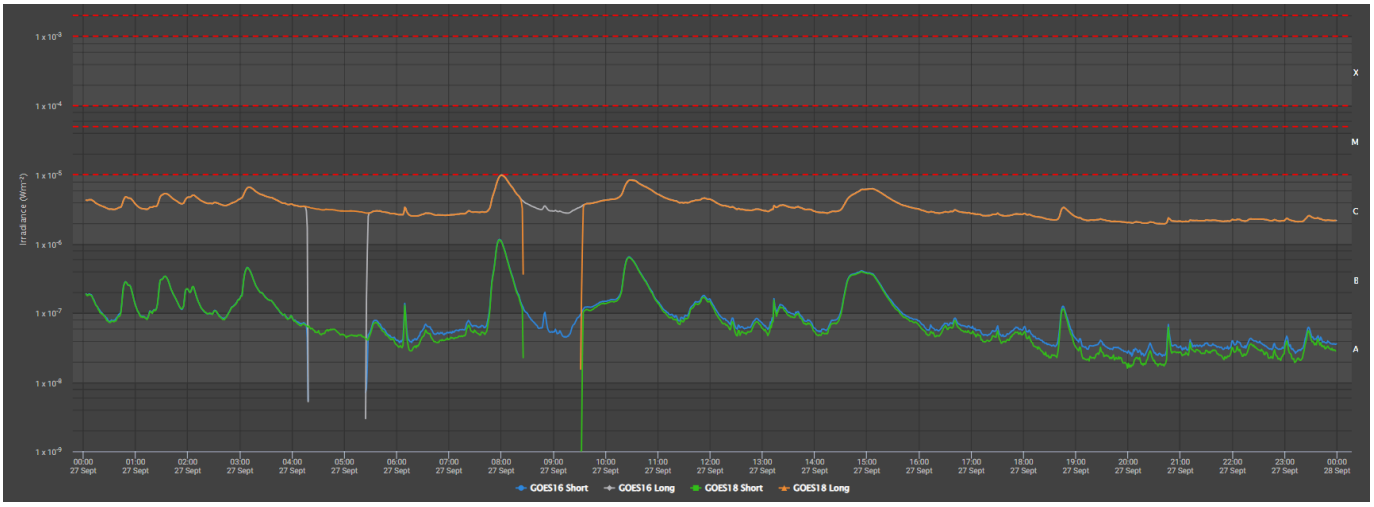
Solar activity has been Moderate with the largest flare M0.9 at 27/0800 UTC, most likely from AR3839 as it lay across the southeast limb.

The majority of the sunspot regions are small and simple, with the most complex regions in the southern hemisphere. The largest region on the disc is AR3836, in the southeast. This region consists of a number of spots of one polarity, with weak trailing spots of opposite polarity leading to a marginal Cao/Beta configuration. AR3835, near south centre disc, has seen further maturation of penumbra and the growth and consolidation of a number of small intermediate spots. AR3839, near the southeast limb, remains difficult to assess due to foreshortening and it may be that this sunspot group becomes split into two separate regions on subsequent analyses. This region was responsible for the largest flare of the past 24 hours, although it was a very low level M-flare.

Regions AR3827 and AR3828, both in the southwest, are due to depart the disc during Days 1-2 (28-29 Sep). From far side soundings and brightness on SDO imagery close to the eastern limb, it is likely there are further regions to rotate onto the disc during the period, however until they become visible it is difficult to assess how much they are likely to affect solar activity. At the present time, flare risks have been maintained. Low to Moderate activity is expected with a a chance of further isolated M-class flares.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 (M Class)**	Yes	50	50	50	50
Very Active	**R3-R5 (X Class)**	No	5	5	5	5

Figure 5: GOES16 and GOES18 X-ray flux over the last 24 hours, showing Low to Moderate activity.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is forecast to persist at background levels, with only a very slight chance of rising above the S1/Minor Radiation Storm threshold.

The current visible sunspots are generally small and simple providing only modest contributions to flare risk, and are unlikely to significantly impact proton flux at Earth. However, given the number of notable filaments currently on the disc, there is also a non-zero, albeit very low chance of observable protons should any significant filament eruption occur during the period.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

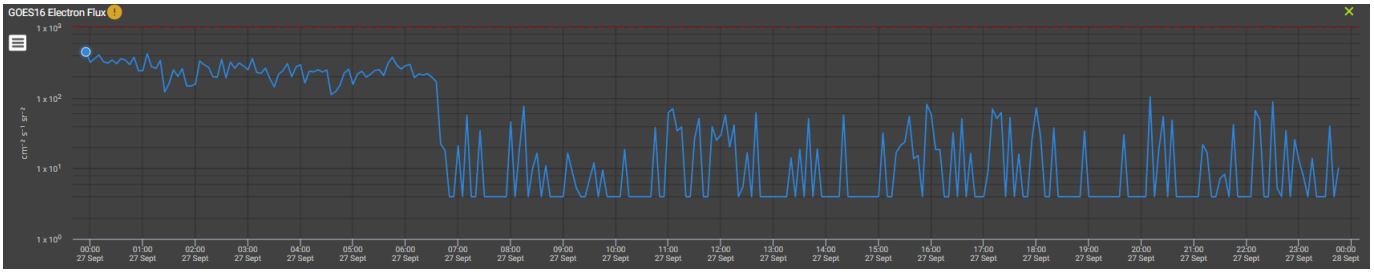
High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) observed by GOES16 was at moderate levels until around 27/0630 UTC, since which time it has been predominantly at background. No enhancement is expected to electron flux values over the coming day. However, any fast wind enhancement from CH76 has the potential to suppress the observed flux during Days 1-2 (28-29 Sep) with some slight recovery anticipated by Day 4 (01 Oct). Diurnal fluctuations of background to moderate are most likely, perhaps seeing a diurnal peak of High towards the end of the period following any HSS enhancement.

The associated 24 hour fluence is currently below the Active threshold and saw a declining trend through 27 Sep. MOSWOC REFM forecast values mirror the observed fluence pattern during 27 Sep and is considered reasonable guidance through the period. Fluence levels are unlikely to reach Active. Confidence is low at this time for Day 3-4 due to the likely weak HSS onset.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	5	5
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

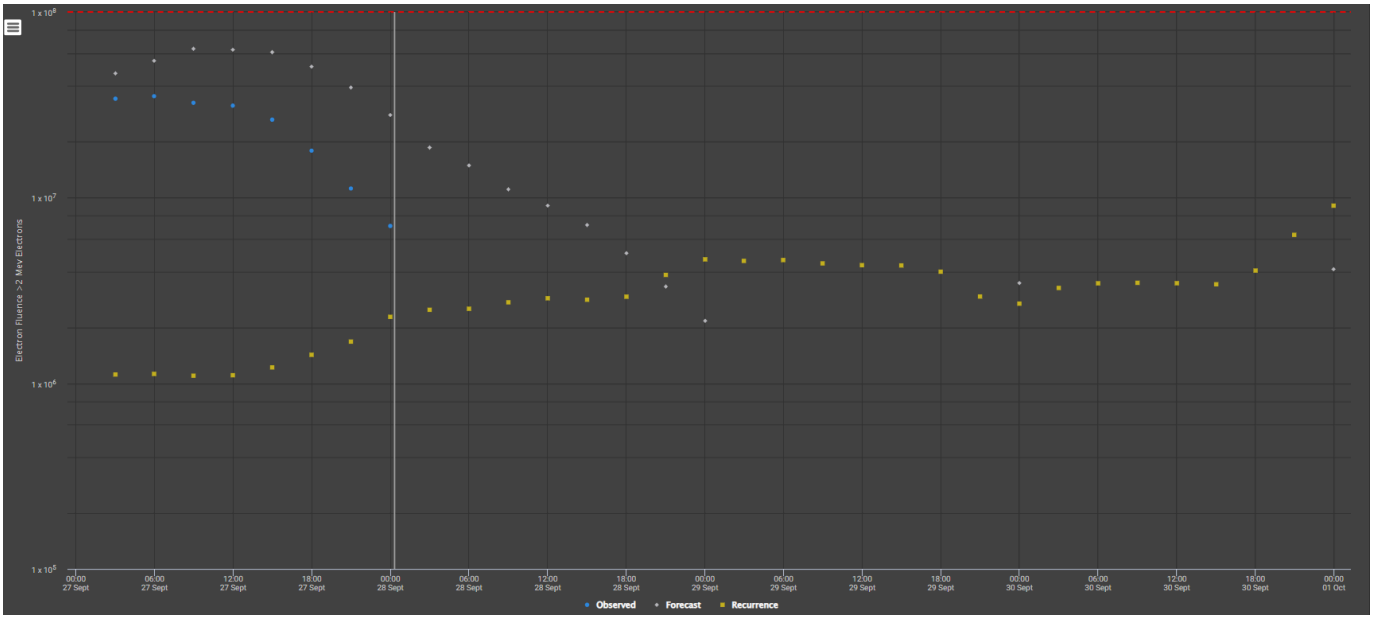
Figure 6: GOES16 Electron flux, showing a steep drop off around 27/0630 UTC.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 7: MOSWOC REFM showing a drop off in fluence values.



© Crown Copyright 2024. All Rights Reserved.